瓜實蠅之生態研究[1,2]

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摘要：瓜實蠅各蟲期，在臺灣南部，週年可見到，但其成蟲的出現盛期則爲6至8月間。其寄主植物，經在臺灣南部調查結果，乃以葫蘆科種類爲主，茄科中之番茄，在果實成熟時偶有發現被其寄生，但茄子類却從未發現被其爲害。在葫蘆科諸寄主中，以甜瓜類之黃香瓜、綠香瓜、苦瓜及越瓜等被害最烈，胡瓜、絲瓜等次之，其餘瓜類雖有被害，但不甚嚴重。其成蟲之棲息處所，以番石榴、柑桔、柚子、檸檬、芒果等果樹園爲最多。其在一日中之活動盛期，乃受上午9點時溫度之高低所左右。其活動之適宜溫度爲19至 29°C。

瓜實蠅（*Dacus cucurbitae* Coquillett, Trypetidae），爲葫蘆科瓜果類的主要害蟲。多分佈於熱帶及亞熱帶地區。臺灣氣候和暖，四季如春，適其孳生繁衍，故在栽培季節，多數瓜類均受害甚烈。據陳貴華1958年12月間，在本省西部各縣市調查結果，瓜類被害率平均高達32.5%，導致損失相當嚴重。

臺灣栽培之瓜類種類相當多，產量很豐富，部份種類除供自給外，尚有大量可資外銷。但由於瓜實蠅爲害，不但降低產量及品質，且足影響外銷。

目前對瓜實蠅問題，有關方面均甚重視。雖然早在1958年經農復會和鳳山熱帶園藝試驗分所，應用蛋白質水解物和馬拉松可濕性粉劑，在全省作防除示範，效果卓著，但其寄主植物種類甚多，且其成蟲棲宿作物（Harbor crops）亦甚複雜，致該蟲發生仍甚猖獗。目前省內有關其生態文獻甚少，承農業研究中心補助，對瓜實蠅寄主植物種類、週年發生情形及其成蟲棲宿作物種類與夫越冬處所等，在臺灣南部加以調查，供作防除措施參攷。

材 料 及 方 法

瓜實蠅寄主植物種類調查，以本省普遍栽培之葫蘆科及茄科等果蔬爲主。葫蘆科有越瓜、胡瓜、甜瓜（黃香瓜及綠香瓜）、西瓜、絲瓜、南瓜、苦瓜、扁蒲（青目匏、牛腿匏）等；茄科則有番茄及茄子等。

將上述瓜類及茄子類作物在年中分數次栽種，每種瓜或茄類均種三畦，每一畦之果實分別爲一採摘期，即在幼果謝花後5天、10天及15天等三種不同採摘期。其方法爲在瓜類開花期中，每天用不同顏色的塑膠布，紮在瓜之果柄，至採瓜之日期，把同一顏色之果實摘下。摘下之果實稱其重量後分別放在試驗室 50×38×18 公分木箱中，箱底舖一層厚約 2—3 公分的細砂，置果實於砂上，俾瓜實蠅化蛹於砂中，待果實腐爛後一週內，開始用鐵絲網篩，篩出砂中的蛹，分別列入記錄，至瓜採收完畢爲止。

成蟲棲宿作物調查，應用雄性瓜實蠅引誘劑，大茴香丙酮（Anisylacetone）98% 加工業級

1. 本著作之完成得國家科學委員會及中正科學技術研究講座基金董事會之研究補助，及農業研究中心（TARC）：69-A11-A-1941，70-A11-A-2034-G，71-A11-A-2123a 等計劃之經費補助，文成後復蒙中興大學張主任書忱斧正，謹此一併深致謝忱。

2. 試驗報告農試字第 575 號

3. 臺灣省農業試驗所鳳山熱帶園藝試驗分所技正兼系主任。

DDVP 2%，置於塑膠誘器中的燈芯狀脫脂棉中，分別掛於臺南、高雄、屏東等地區的果園中，每半月調查其誘殺蟲數一次，並添置引誘劑。

瓜實蠅在一天中之活動時間調查，將上述之誘殺器，掛在胡瓜園中，每日分別於9：00、12：00、15：00 及 17：30 等時間，計算誘殺器中之瓜實蠅數，列入記錄，並記載當時田間之溫度。

結　果　及　討　論

瓜實蠅在臺灣南部，只要有適宜寄主植物，則週年孳生不息。由田間採回瓜果，置於室內育蟲箱中，全年各期所採者均可篩出瓜實蠅蛹體（表１）。其成蟲亦全年各月都有出現。據在臺南、高雄、屏東等三地區所作調查結果，其成蟲出現在全年中有三個高峯。第一次高峯在２月，第二次高峯在６至８月，第三次高峯在12月，其間第一谷底在４月，第二谷底在十月，第三谷底在１月（圖一）。影響此種消長情形之主要因素爲各種瓜類在南部之栽培期間。6～8 月間爲南部瓜類盛產期。如河床地之西瓜，及第一期水稻裡作之甜瓜（黃香瓜）等均在此期間結果，致其成蟲密度大增，形成第一高峯。因 8～9 月間有颱風及豪雨侵襲，故於 10 月間成蟲密度降低。10月以後雨量減少，其密度復再增加，至12月間形成第三高峯。西瓜及胡瓜在河床地及零散旱地續有栽種，此後氣溫逐漸降低，影響其成蟲活動，於一月間密度大形減少，形成第三谷底。但於２月間蟲口又增，形成第二高峯。3月以後氣溫雖漸昇，因值第一期水稻栽植期，瓜類種植較少，致於４月間瓜實蠅密度最低，在消長圖上形成第一谷底。

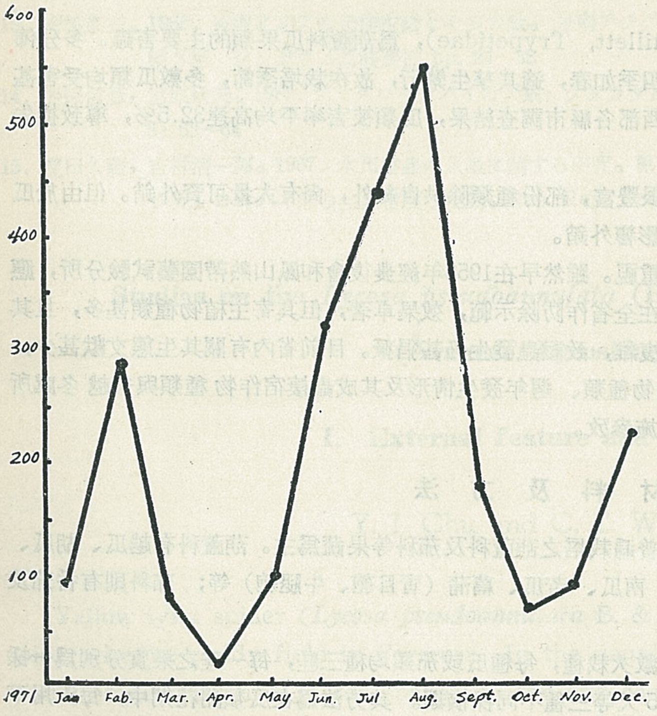

圖 1.　高雄地區瓜實蠅發生消長情形

Fig. 1.　Seasonal population of melon fly in Kaohsing area

瓜實蠅之寄主植物，供試葫蘆科七種中十品種均有被害；茄科中之茄子始終未發現被害，僅在果實黃熟後才有被害。瓜實蠅對瓜類不同品種之好惡，仍有顯明差別。若以蛹數及果重相互比較（表２），則顯示其所好的瓜類依序爲黃香瓜、綠香瓜、苦瓜和越瓜等。次爲胡瓜及絲瓜。至西瓜、南瓜、牛腿匏及青目匏等被害最輕。

瓜實蠅在瓜類落花後產卵於果實上爲害，其對果實成熟度之嗜好似隨瓜果種類不同而有差別，茲經分別在開花後５天、10天及15天等三個時期，採摘瓜果調查，各種瓜類之被害情形：苦瓜在開花後經過日數愈久者，所出瓜實蠅之蛹數愈多，即其被害隨苦瓜之成熟而益加嚴重；甜瓜、越瓜、胡瓜、絲瓜、西瓜等則於落花後較早期採摘者，所出瓜實蠅之蛹數較多，即其被害時期多在幼瓜；牛腿匏和青目匏則其幼果及中果之被害程度無差別，即其被害程度隨瓜果之增長而加大。此種現象，可能與瓜皮組織，如厚薄、硬度以及絨毛之有無及多寡等有密切關係。苦瓜表皮光滑具瘤，其厚薄及硬度在幼

表 1.　瓜實蠅寄主植物種類及其週年發生調查

Table 1. Investigaton of host range and occurrence of melon fly

寄主植物 Host plants	謝花後日數 Days after fruit forming	每個果實平均蛹數 Average No. of pupae per fruit			
		6/2-8/18,'69	8/25-10/24,'69	12/22,'69-4/9,'70	4/13-6/10,'70
越瓜 Oriental pickling melon	5	34.29	3.55	被菜潛蠅為害中止發育 Damaged by leaf miners	6.84
	10	8.70	0		2.92
	15	—	0		0.16
綠皮甜瓜 Muskmelon (Green)	5	5.05	1.47	被菜潛蠅為害中止發育 Damaged by leaf miners	2.90
	10	14.92	0.35		6.22
	15	12.00	0.26		6.30
黃皮甜瓜 Muskmelon (yellow)	5	15.09	3.31	被菜潛蠅為害中止發育 Damaged by leaf miners	2.29
	10	24.71	0		1.20
	15	25.20	0		0.54
西瓜 Water melon	5	2.33	0	蔓割病 Fusarium wilt	18.07
	10	12.11	0		1.51
	15	50.00	0		3.54
絲瓜 Vegetable sponge	5	3.07	1.72	0.27	2.56
	10	3.04	15.54	4.63	0.57
	15	0	1.17	0	0.13
胡瓜 Cucumber	5	9.02	0.03	5.23	2.06
	10	10.57	5.16	13.11	0.38
	15	26.64	0	26.57	4.26
南瓜 Squash	5	30.40	1.96	0.90	4.65
	10	0	0	0	0
	15	0	0	0	0
苦瓜 Bitter cucumber	5	2.47	4.62	不結果 No. fruit	6.37
	10	4.91	5.91		11.78
	15	1.02	13.88		13.60
青目匏 Calabash gourd(1)	5	6.51	1.56	2.00	5.58
	10	6.46	21.13	1.67	1.00
	15	38.69	11.53	3.17	7.92
牛腿匏 Calabash gourd(2)	5	6.75	0.09	3.27	3.76
	10	27.90	0.75	4.33	4.50
	15	10.94	0.40	0.75	1.37
番茄 Tomato	5	0	0	0	0
	10	0	0	0	0
	15	0	0	0	0
茄子 Egg plant	5			0	0
	10	—	—	0	0
	15			0	0

果和成果間無甚差別，故瓜實蠅在苦瓜落花後任何期間皆可產卵為害。至在甜瓜、越瓜、胡瓜、絲瓜、西瓜等，其幼果果皮薄而嫩、瓜實蠅產卵較易，致被害程度較重，隨瓜果之生長其果皮逐漸堅厚，瓜實蠅產卵較難，使其被害程度逐漸輕微。扁蒲類之牛腿匏和青目匏，幼果果皮絨毛密長，瓜實蠅難於產卵，被害較輕，漸長後果皮絨毛逐漸稀疏，瓜實蠅易於產卵，致其被害漸較嚴重。但以果重和所出瓜實蠅之蛹數相較，則扁蒲類之幼果及中果被瓜實蠅為害程度無甚差別。

表 2.　瓜實蠅對各寄主植物之嗜好性比較

Table 2. The comparison of host plant preference of melon fly in 1971

寄主植物 Host plants	謝花後日數 Days after fruit forming	平均蛹數/100公克果重 Average No. of pupae/100g of cucurbit					
		Mar.	Apr.	May	June	July	Aug.
越瓜 Oriental pickling melon	5	—	48.78	48.52	162.66	45.83	—
	10	—	—	18.44	25.71	0	—
	15	—	—	7.43	0	—	—
綠皮甜瓜 Muskmelon (Green)	5	—	42.46	77.85	52.98	71.21	—
	10	—	43.89	19.59	44.07	18.03	—
	15	—	4.86	9.06	0.40		—
黃皮甜瓜 Muskmelon (yellow)	5	—	70.94	108.21	107.58	—	—
	10	—	11.14	13.62	102.13	—	—
	15	—	0	44.96	166.21	—	—
西瓜 Water melon	5	—	0	2.19	27.17	—	—
	10	—	—	0.93	2.12	1.64	—
	15	—	—	1.82	0.56	—	—
絲瓜 Vegetable sponge	5	11.81	2.75	2.66	0	0	0.14
	10	0	1.61	1.69	0.41	5.97	0
	15	—	0	0.47	0	0	—
胡瓜 Cucumber	5	2.11	29.91	—	0	0	2.04
	10	—	10.22	—	—	—	45.16
	15	—	11.92	—	—	—	—
南瓜 Squash	5	—	0.32	0	—	—	—
	10	—	10.12	0	—	—	—
	15	—	0	0	—	—	—
苦瓜 Bitter cucumber	5	—	—	28.52	16.89	11.70	16.97
	10	—	—	37.65	26.82	18.71	—
	15	—	—	55.97	15.69	18.57	—
青目匏 Calabash gourd(1)	5	—	—	0.32	0	0.79	0
	10	—	—	1.03	1.48	2.55	0
	15	—	—	0.03	3.72	0	—
牛腿匏 Calabash gourd(2)	5	—	—	1.22	10.20	2.16	—
	10	—	—	1.38	0	2.19	—
	15	—	—	0.02	0	8.29	—

瓜實蠅成蟲，僅在產卵時期，飛臨瓜園，平時多棲息於其他作物上或果樹上。經在臺南、高雄、屏東等地選各種果園，作週年誘殺調查所得結果（表３）顯示，瓜實蠅成蟲停留在番石榴、柚子、柑桔、檬檸及芒果等果樹上者爲數最多。可能因爲該等果樹上有介殼蟲類或蚜蟲類爲害，此類害蟲所分泌之蜜露（Honey dew）最爲瓜實蠅成蟲所嗜食，所以平時多棲集於此等果樹上。尤其幾種果樹混雜栽植，且此等果樹又爲粉介殼蟲或蚜蟲等所喜寄生者，則瓜實蠅成蟲之密度，常較其他果園只有一種果樹者遠高。

瓜實蠅成蟲在臺灣南部，明顯地週年均有出現，但在各地區之消長頗不一致。此種現象係受當地環境因子的影響。如瓜類栽培時期之早晚；瓜實蠅成蟲所棲息之果樹種類，是否經過修剪及常噴農藥；溫度、濕度、雨量、風向、風速以及其他種種繁複因子，在在均足影響瓜實蠅之棲息密度及消長情形。

瓜實蠅成蟲一天中之活動情形，經在胡瓜園中，每日分爲9：00,12：00,15：00,17：30等四段時間調查。所得結果（表４）顯示，於晴朗的天氣，瓜實蠅每天在此四段時間中之活動有顯著不同之區

表 3. 瓜實蠅雄蟲在不同果樹上發生消長

Table 3. Seasonal population of male melon fly on different fruit trees

調查地區 Locality	棲息果樹 Harbor fruit trees	月份 Month (1971) Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.
屏東 Pintung	柚子 Pomelo	45	70	108	75	68	292	294	83	33	30	22	11
	牛心梨 Bullock's heart	2	33	14	21	27	127	36	196	101	47	10	8
高雄 Kao-shsiung	柚子 Pomelo	85	289	76	13	97	314	433	548	174	64	85	226
	檸檬 Lemon	54	31	28	15	26	78	53	24	2	16	18	38
	芒果 Mango	22	50	12	2	0	33	66	63	11	18	77	101
	楊桃 Carambola	1	0	1	18	30	51	21	238	9	54	7	8
	荔枝 Litchi	0	1	0	0	2	31	31	39	9	13	16	38
	番石榴 Guava	0	0	4	27	126	350	679	168	14	30	5	8
臺南 Tainan	番石榴 Guava	241	166	286	166	47	34	31	11	22	169	169	206
	柚子 Pomelo	96	113	57	4	13	0	51	39	58	200	203	259
	柳橙 Orange	168	101	40	23	33	346	94	27	146	294	161	204

分，而其出現時之多寡，乃受氣溫所左右。瓜實蠅可以活動之溫度範圍為16至34°C，適其活動之溫度為19至29°C。一般而言，瓜實蠅之出現在中午以前恆較中午以後為多。但中午以前之從天亮至9點和從9至12點此兩段時間亦有明顯之區分，且隨氣溫之高低而互有短長。

從12月至3月此數月間，上午9點之氣溫平均在23°C以下，瓜實蠅之出現以9～12點多於由天亮至9點。但從4月以後，上午9點之平均氣溫為27°C以上，由天亮至9點瓜實蠅之出現便多於由9～12點。所以上午9點氣溫之高低，可以左右瓜實蠅在一天中活動最多之時間。由此調查資料觀之，其關鍵之溫度乃在23～27°C之間。依作者推斷，上午9點之氣溫若在25°C以上，可能為瓜實蠅活動最適宜之溫度。

另一現象為午後12至15點此段時間內瓜實蠅出現之多寡和上午天亮至9點瓜實蠅出現之多寡，亦和上午9點時氣溫之高低有密切關係。如從12月至2月上午9點之平均氣溫均低於20°C，則12—15點時瓜實蠅之出現恆較天亮至9點時為多，但從3月以後，上午9點時之氣溫高於20°C，則上午從天亮至9點時瓜實蠅之出現便較12～15點時為多。

由上述之情形觀之，瓜實蠅在每日諸時間中出現之多寡，可由上午9點時氣溫之高低而予推斷。茲節略如下:

㈠ 若上午9點時之氣溫低於 20°C 時，則瓜實蠅在一天中之出現以 9～12 點為最多，12～15

表 4. 雄性瓜實蠅在胡瓜園中一日內之活動時間和氣溫關係

Table 4. The active period of male melon fly in relation to temperature in cucumber field during a day

月份 Month (1971—1972)	雄性瓜實蠅活動時間 Active period of male melon fly — 9 : 00		—12 : 00		—15 : 00		—17 : 30	
	平均溫度 Mean temperature	蟲數 No. of fly	平均溫度 Mean temperature	蟲數 No. of fly	平均溫度 Mean temperature	蟲數 No. of fly	平均溫度 Mean temperature	蟲數 No. of fly
Dec.	18.02	55	21.96	330	22.15	96	18.84	5
Jan.	16.84	8	21.13	58	21.53	22	18.39	5
Feb.	17.01	10	22.32	69	23.49	12	19.30	2
Mar.	22.93	19	25.76	22	27.33	3	23.31	3
Apr.	27.03	86	29.44	13	29.87	2	25.40	1
May	30.04	97	31.70	10	30.76	2	27.63	0
June	30.65	4	32.33	1	31.58	1	29.51	0
July	28.53	3	30.26	0	29.86	2	27.48	0
Aug.	27.75	42	29.75	4	29.41	2	26.72	0

點次之，天亮至 9 點又次之，15 點以後最少。

㈡ 若上午 9 點時之氣溫在 21～25°C 時則瓜實蠅在一天中之出現仍以 9～12 點為最多，但天亮至 9 點時次之，12 點以後又次之。

㈢ 若上午 9 點時之氣溫在 25°C 以上，則瓜實蠅在一天中之出現，必依序為天亮至 9 點時最多，9～12 點次之，12～15 點又次之，15 點以後便沒有瓜實蠅出現。

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A study on the ecology of melon fly

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The melon fly. *Dacus cucurbitae* Coquillett, has long been a serious pest of cucurbitacious crops in Taiwan. The losses of production caused by melon fly were estimated over 30%

This study is chiefly concerning with the preference and abundance of melon

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fly, and the habitats where flies mostly tend to congregate.

Degree of preference of the fly for its host was evaluated by growing several species of cucurbitaceae and solanaceae in field all year round. Different stages of fruits which formed after 5, 10 and 15 days were taken from field to laboratory and placed over sand in holding boxes to recover pupae developing from immature larvae in the host material. The sand was screened weekly and pupae were then counted.

Habitats of the melon fly were investigated in Tainan, Kaohsiung and Pintung areas. Male attractant, anisylacetone 98% added DDVP technical grade 2%, was used to attract male fly in the plastic traps which were hung under the trees of orange, pomelo, lemon, guava, mango, carambola and bullock's heart. The traps were emptied and attractant renewed twice a month.

Activity period of melon fly also was investigated by using the same procedure of trapping the male fly in cucumber field. Flies were counted on daily at 9: 00, 12: 00, 15: 00 and 17: 30. Temperatues of atmosphere, showing on the thermometer hung in the cucumber field, were recorded at the same time.

From the information gathered in both field and laboratory, flies of any life stage could be found year round in southern Taiwan (Table 1). Their surge of abundance concentrated in the period of June to August. This might correlate with the fruiting peak of water melon and muskmelon which were popularly and abundantly grown in river-beds and areas where these melons were planted with the first crop of rice. During August and September, there were the typhoons as well as heavy rainfall, population of melon fly was suppressed sharply to its lowest level. After October, the raining season was over, water melon and cucumber were again grown in both the river beds and the rice field after second crop, population of melon fly raised again to its second peak. Melon fly was sparse in the months of March to May when the spring grown water melon was still at the young stage. Other varieties of cucurbit were scarcely grown because the first crop of rice was in the growing season (Fig. 1).

Preference of melon fly was evaluated by counting the number of pupae per 100 grammes weight of cucurbit. The results, as shown in Table 2 revealed that the flies preferred bitter cucumber, muskmelon and oriental pickling melon best, cucumber and vegetable sponge the next, water melon, squash and calabash gourd the least. Infestation of flies varied in ages of fruits in different varieties of cucurbit. The characteristics of eggs deposition of melon fly, might be affected by the structure of the skin of cucurbitacious fruits. The skin of bitter cucumber, for example, was very smooth and tender into which flies preferred to lay their eggs any time before the fruits were harvested. For water melon, squash and vegetable sponge, the skin of which were very tender in the early stage of young fruit, into which flies prefer-

red to lay their eggs too. But flies could rarely cause much damage to the full grown fruits as the skin of which getting harder. Flies did not lay as many eggs into the young fruits of calabash gourd as they did into the other fruits of cucurbit though the skin of young calabash gourd fruits were tender too. It might be due mainly to the fuzzy skin of the young fruits of calabash gourd which hindered the flies laying eggs. Flies did not damage in green stage of tomato fruits, but few pupae of melon fly had been obtained from the fruits as the skin of which became pink in color about 1/3 or more of the fruit surface.

Male melon flies were trapped mostly in fruit trees such as guava, orange, lemon, pomelo and mango year round in Tainan, Kaohsiung and Pintung areas. More flies were trapped in the mixed planting of guava, pomelo, mango and longan. On these fruit trees, many insects such as mealy bugs and aphids always produced a great deal of honey dew which the flies preferred. It was clearly shown that the flies did not remain in the field of cucurbit beyond deposition of eggs.

Fluctuation of flies varied from place to place. It might be affected by local environment, such as the different growing seasons of cucurbit and the uncertain local showers that occurred during July to September. Pruning the tree also caused the flies to move out of the field, as shown in Table 3 in Kaohsiung area, when the leaves of guava were pruned in January, there was not any fly caught thereafter. But the flies increased gradually as the new leaves of guava grew.

Timing activity of melon fly was observed daily at different hours of the day from December 1971 to August 1972. Large numbers of melon flies were caught in traps before noon in sunny days, as shown in Table 4. An extraordinary number of flies usually caught on the bright and warmer days after several days of low temperature and light rain during the spring season. Activity of melon fly also evidently influenced by temperature. The lowest and the highest temperature that the melon flies appeared ranged from 16 to 34°C, but the favorable temperature range seemed to be from 19 to 29°C. There was evidence indicating that the peak activity of melon fly during a day was mainly affected by the temperature showing at 9:00. Several indications which revealed from the data would be worth to be summarized as in the following:

(1) If the temperature was below 20°C at 9:00, the number of melon flies trapped during 9:00-12:00 would be the highest, 12:00-15:00 the second, dawn to 9:00 the third, after 15:00 the least.

(2) If the temperature was between 21-25°C at 9:00, the number of melon flies trapped during 9:00-12:00 would be still the highest, but the second would be changed during dawn to 9:00, and the least after 12:00.

(3) If the temperature was above 25°C at 9:00, the number of melon flies trapped would be orderly during dawn to 9:00 the highest, 9:00-12:00 the second, 12:00-15:00 the third, but there would be not any fly appeared after 15: 00.